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FINAL REPORT
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We have received and processed all samples for either light or scanning electron microscopic analysis and have completed the histomorphometric analysis. We have characterized the changes caused by spaceflight to tendon attachments to the calcaneus, tibia, fibula and femur and compared them to hindlimbs and forelimbs from NIH.R2. Soleus muscle histomorphometry has also been completed. Our results suggest severe osteoporosis in the femur, fibula and tibia of animals coincident to spaceflight, which had not resolved after 4-5 days following return to earth. This was evident at all sites, including sites of tendon attachments. This atrophy was not evident in the calcaneus. No muscle atrophy was evident. Comparison of scanning photomicrographs of flight animals with other lactating animals demonstrated structural similarities and suggested that it might be worthwhile to assess whether lactation is a factor in development of the osteoporosis in the spaceflight animals. In addition, evaluation of total calcium utilization by spaceflight animals would be beneficial.

EARTH BENEFITS

Osteoporosis is a disease which affects many people. There has been a debate for many years concerning factors which might cause osteoporosis. Many people feel that inactivity may be a primary cause of the disease. Spaceflight is an excellent way to produce bone inactivity, as the bones receive no load in microgravity. In this study, all spaceflight animals developed osteoporosis, suggesting that spaceflight could be a factor in development of osteoporosis if the flight was of sufficient length. Since rat bone is similar to human (but its metabolism is much more rapid than human) when osteoporosis occurred in rats during a 11 day flight, it would could occur in humans experiencing a longer (3 month) spaceflight. There was evidence of microfractures in the tibia of spaceflight rats, suggesting that bones weakened by osteoporosis during spaceflight may fracture on return to earth. This event could disable astronauts on their return to gravity. The results of this study also suggested that loading

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bones weakened by osteoporosis will not promote healing, but will likely result in fracture. Since the experimental animals were pregnant females, we suggest that pregnancy may also have a role in the bone atrophy.

INVENTIONS STATEMENT

No inventions resulted from this study.

ABSTRACTS

Johnson, R. B.; Tsao, A. K.; St. John, K. R.; Betcher, R. A.; Tucci, M. A.; Parsell, D. E.; Mushell, N.; Zardiackas, L. D.; and Benghuzzi, H. A. (1995) Effects of spaceflight on the attachment of tendons to bone. ASGSB Bulletin, 9: 97.

Johnson, R. B.; Tsao, A. K.; St. John, K. R.; Betcher, R. A.; Tucci, M. A.; Parsell, D. E.; and Benghuzzi, H. A. (1996) Atrophy of the fibula occurs coincident to spaceflight. Journal of the Mississippi Academy of Sciences, 41: 61.

Parsell, D. E.; Barkley, P. J.; Tsao, A. K.; St. John, K. R.; Betcher, R. A.; and Johnson, R. B. (1996) Effects of spaceflight on rat femoral density. Journal of the Mississippi Academy of Sciences, 41: 63.

Johnson, R. B.; and Abel, S. E. (1996) Comparison of the effects of spaceflight on hindlimb and forelimb bones. ASGSB Bulletin, 10: 59.

Johnson, R. B.; Tsao, A. K.; St. John, K. R.; Betcher, R. A.; Tucci, M. A.; Parsell, D. E.; and Benghuzzi, H. A. (1996) Effect of spaceflight on the structure of the fibula. FASEB J, 10: A753.

PRESENTATIONS

"Comparison of the effects of spaceflight on hindlimb and forelimb bones" Rocky Mountain Bioengineering Symposium, Dayton, Ohio, April 12, 1997.

Rats in Space--Results of the NIH.R1 and NIH.R2 spaceflights. Presented at the Department of Oral Biology, University of Manitoba, September 25, 1997.

"Effects of spaceflight on attachment of tendon to bone." Department of Physiology, University of Mississippi Medical Center, Jackson, Mississippi, July 12, 1995.

"Rats in space". Sigma Xi, Jackson, Mississippi, October 12, 1995.

"Effects of spaceflight on bone: results of Atlantis and Discovery flights", Professional Development Seminar, University of Mississippi, May 2, 1996.